COMP309: Machine Learning Tools and Techniques

Exploratory Data Analysis (EDA)

- Tutorial 5
- week 5
- Baligh Al-Helali

What questions need to be asked about the data before going ahead with processing and modelling?

1. What is the purpose of the data?
2. Which variables are predictive features and what is the target one?
3. What is the size/scale of the data?
4. What are the types of the variables (features and target)
5. Are the data clean?
6. Are the data balanced?
7. The distribution of each variable?
8. How the relationships between the variables look like?
9. Are there any corelations between variables?
10. Are there any missing values?
11. Which features might be more important?
12. …

Why such questions help for processing and modelling?

❑Understand the data helps:

1. Easier to spot mistakes
2. Easier to set hypothesizes
3. Allows you to feel your data
4. Get an idea of how/what the experiment should be conducted
5. …

❑Examples of important decisions based on EDA:

- Type of target ➔ classification or regression
- Data balance➔ performance measure (accuracy, weighted, F1-score)

How to answer such questions?

❑Some questions require reading the documents of the data creators (e.g. Qs 1 and 2)

- Reading the data info and details from the providing websites (e.g. UCI and OpenMl)
- Visiting the creators website or reading the paper(s) that published the data (if any)
- Contacting the data creators (e.g. email)

❑Some questions require extracting statistics and visualisation such as Qs 3-11

- Statistics: count, mean, median, quartiles, variance, …
- Visualisation: histograms, scatterplot, boxplot, heatmap, …

❑How to get the stats and Vizs:

- From the data sources (Not always reliable)
- Using EDA tools:
  - Orange
  - Python: Pandas, Matplotlib, Seaborn
  - …

The subject of this tutorial

We are considering the popular data set “iris”

-The Iris flower data set or Fisher's Iris data set is a multivariate data set introduced by the British statistician and biologist Ronald Fisher in his 1936 paper The use of multiple measurements in taxonomic problems as an example of linear discriminant analysis.[1](Wikipedia)

❑UCI Machine Learning Repository

Iris Data Set

Download: Data Folder, Data Set Description

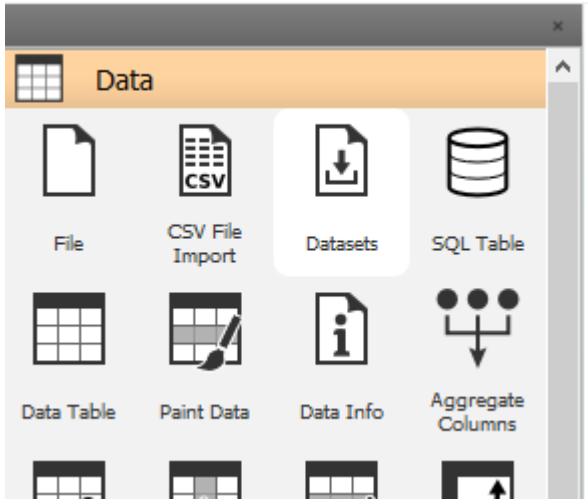
Abstract: Famous database; from Fisher, 1936

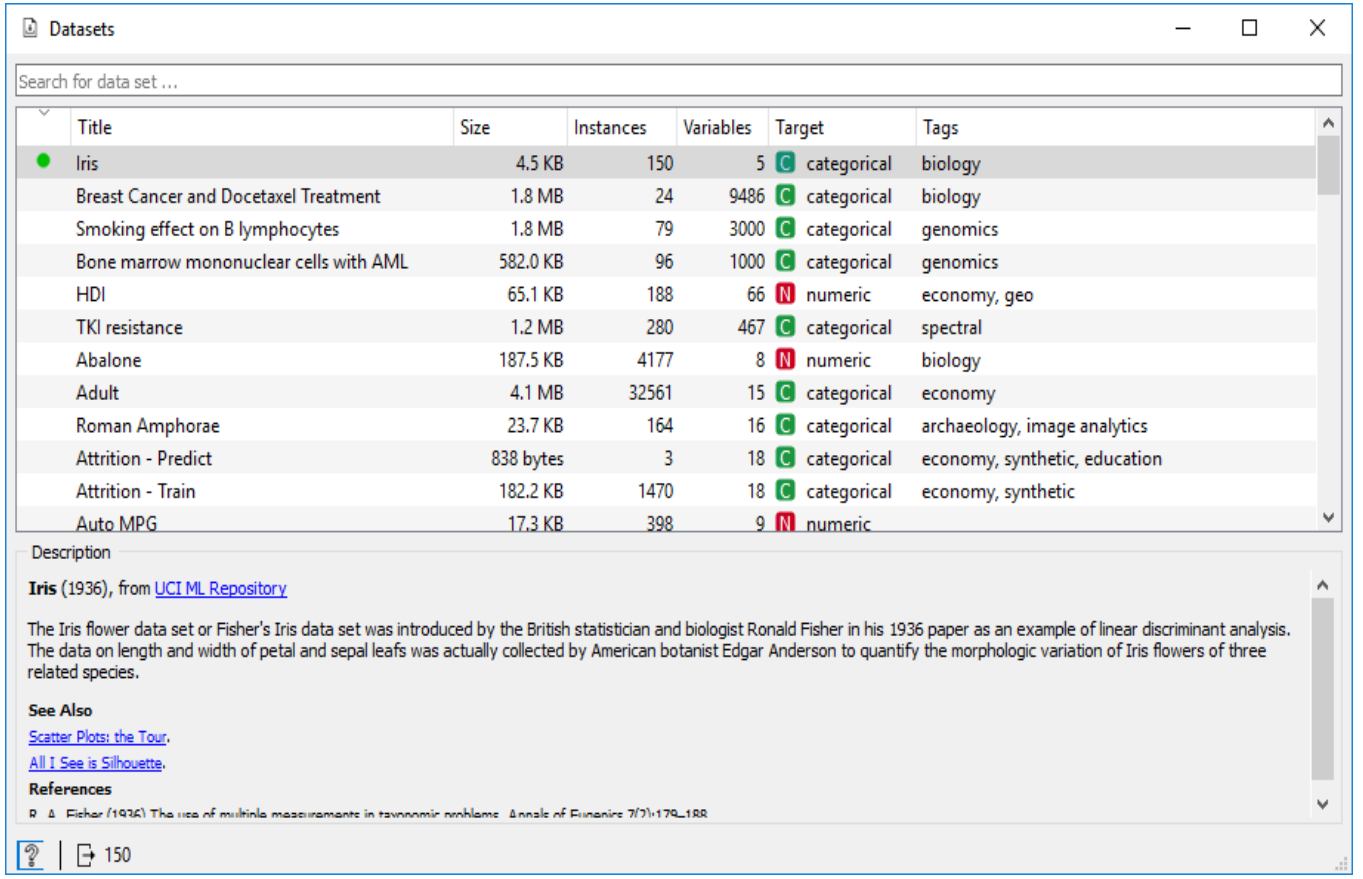
Data Set Characteristics:	Multivariate	**Number of Instances:**	150	**Area:**	Life
Attribute Characteristics:	Real	**Number of Attributes:**	4	**Date Donated**	1988-07-01
Associated Tasks:	Classification	**Missing Values?**	No	**Number of Web Hits:**	4128602

*[1]. R. A. Fisher (1936). "The use of multiple measurements in taxonomic problems". Annals of Eugenics. **7** (2): 179–188. doi:10.1111/j.1469-1809.1936.tb02137.x. hdl:2440/15227.*

Let's start with Orange

- Load the data set

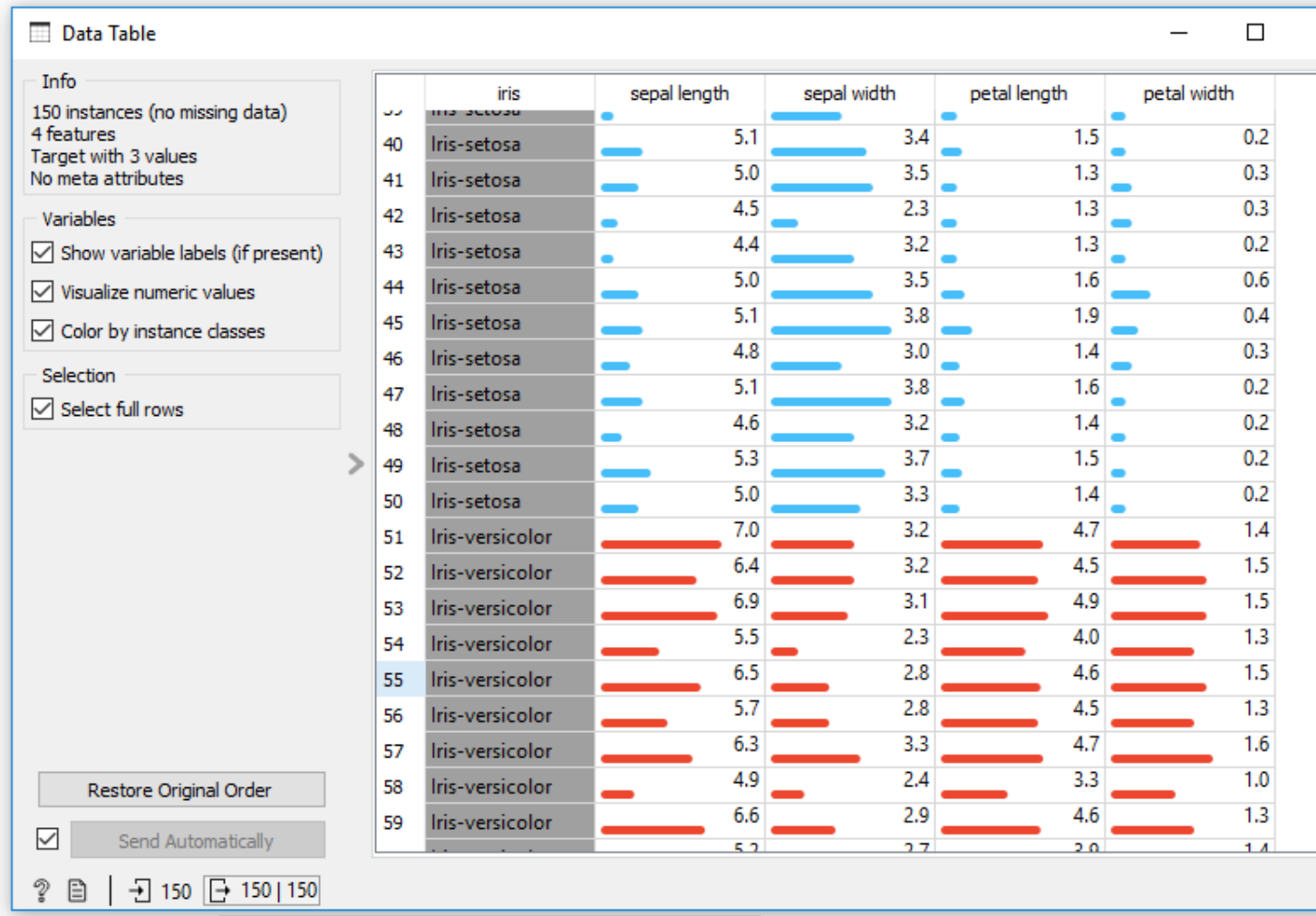




❑What to notice?

- Type of target is categorical ➔ classification
- Data size is small➔ might need cross validation

Orange EDA: A first look



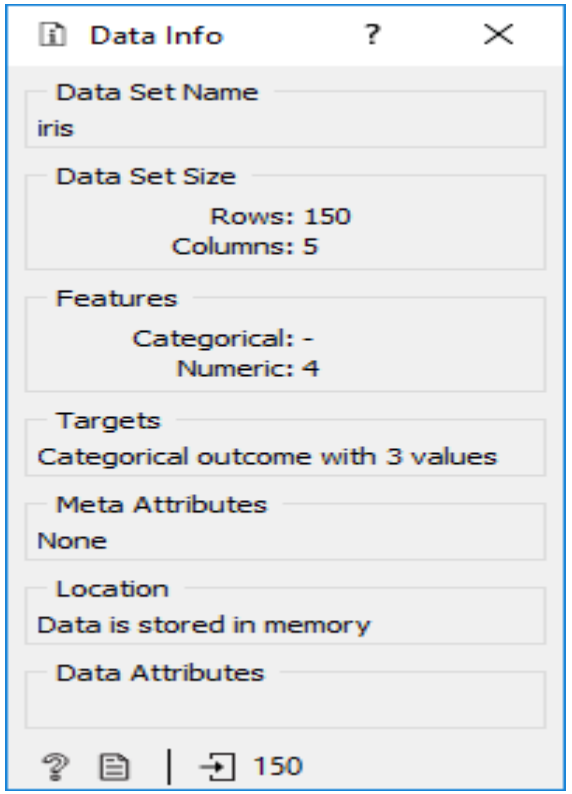
	iris	sepal length	sepal width	petal length	petal width
40	Iris-setosa	5.1	3.4	1.5	0.2
41	Iris-setosa	5.0	3.5	1.3	0.3
42	Iris-setosa	4.5	2.3	1.3	0.3
43	Iris-setosa	4.4	3.2	1.3	0.2
44	Iris-setosa	5.0	3.5	1.6	0.6
45	Iris-setosa	5.1	3.8	1.9	0.4
46	Iris-setosa	4.8	3.0	1.4	0.3
47	Iris-setosa	5.1	3.8	1.6	0.2
48	Iris-setosa	4.6	3.2	1.4	0.2
49	Iris-setosa	5.3	3.7	1.5	0.2
50	Iris-setosa	5.0	3.3	1.4	0.2
51	Iris-versicolor	7.0	3.2	4.7	1.4
52	Iris-versicolor	6.4	3.2	4.5	1.5
53	Iris-versicolor	6.9	3.1	4.9	1.5
54	Iris-versicolor	5.5	2.3	4.0	1.3
55	Iris-versicolor	6.5	2.8	4.6	1.5
56	Iris-versicolor	5.7	2.8	4.5	1.3
57	Iris-versicolor	6.3	3.3	4.7	1.6
58	Iris-versicolor	4.9	2.4	3.3	1.0
59	Iris-versicolor	6.6	2.9	4.6	1.3

❑What to notice?

- Variable scale is different (e.g. sepal length is the widest and petal width is the least)

➔ might need normalization

Orange EDA: A first look

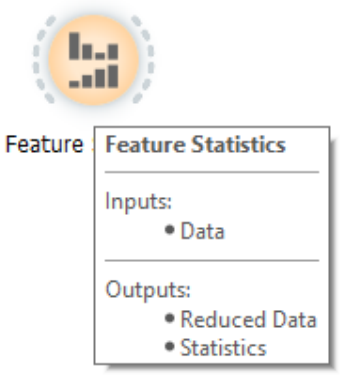


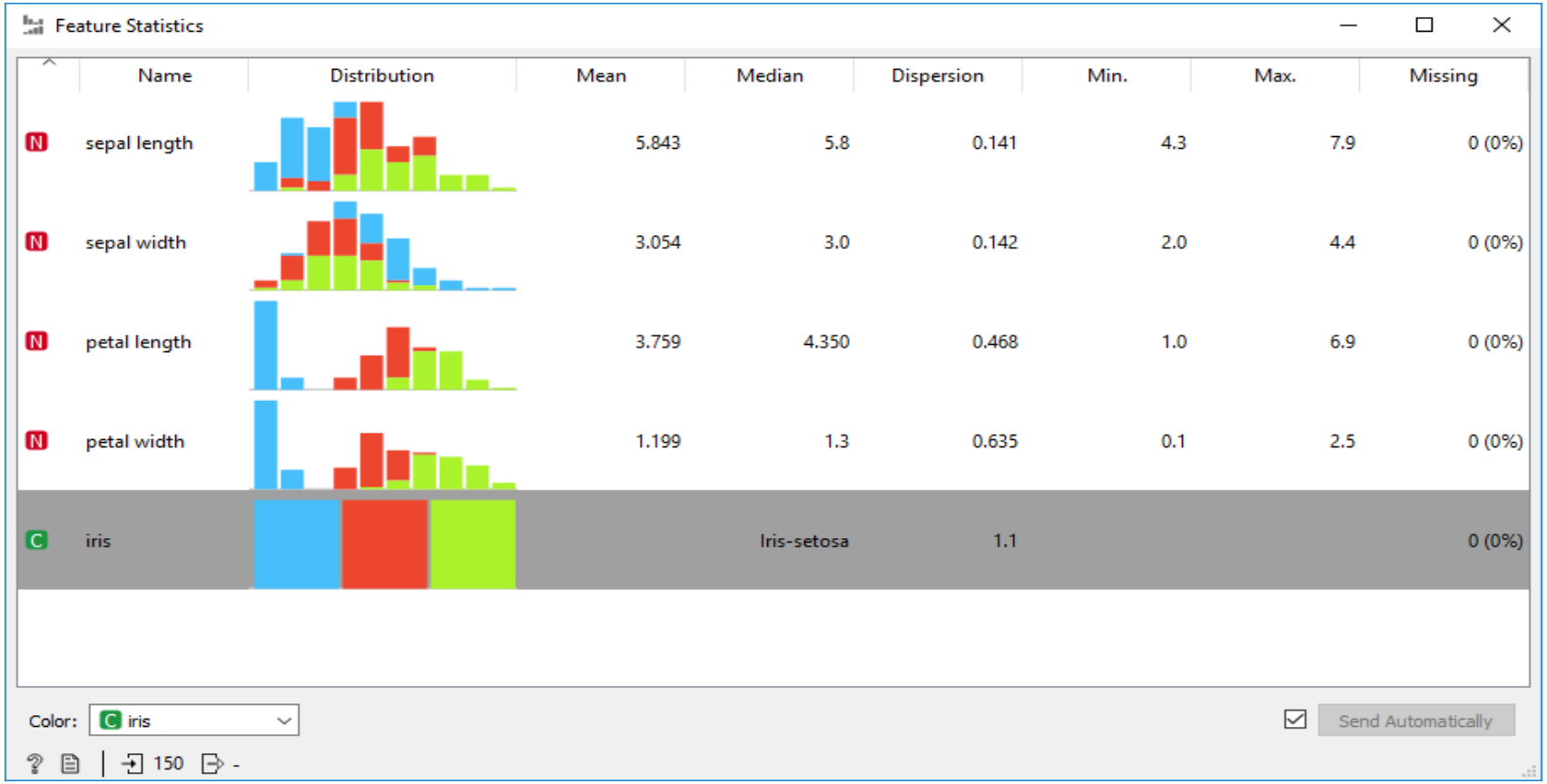
❑What to notice?

- Type of target is categorical ➔ classification
- Data size is small➔ might need cross validation

Orange EDA:

What are the stats of the variables?



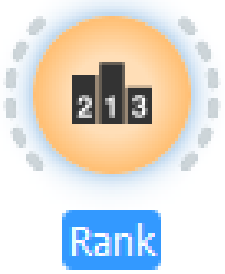


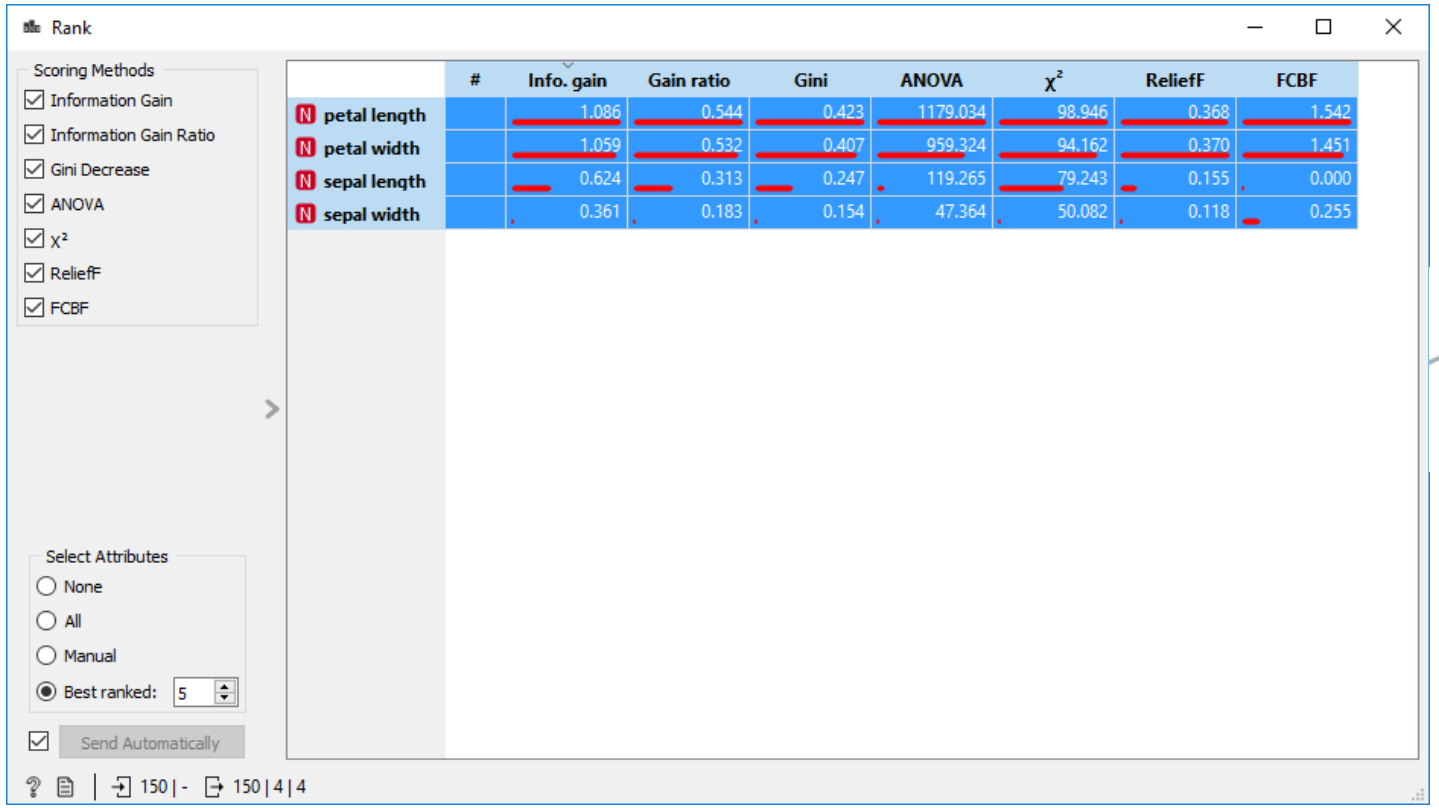
❑What to notice?

- Distributions of variables over classes
- Centre, spread, no missing values of variables
- Classes balance

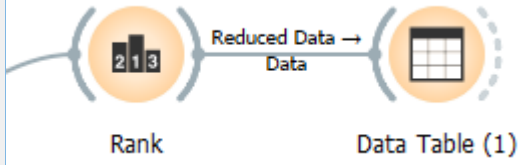
Orange EDA:

What are the most important features?





	#	Info. gain	Gain ratio	Gini	ANOVA	χ^2	ReliefF	FCBF
petal length		1.086	0.544	0.423	1179.034	98.946	0.368	1.542
petal width		1.059	0.532	0.407	959.324	94.162	0.370	1.451
sepal length		0.624	0.313	0.247	119.265	79.243	0.155	0.000
sepal width		0.361	0.183	0.154	47.364	50.082	0.118	0.255



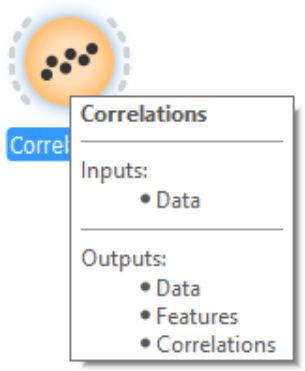
❑What to notice?

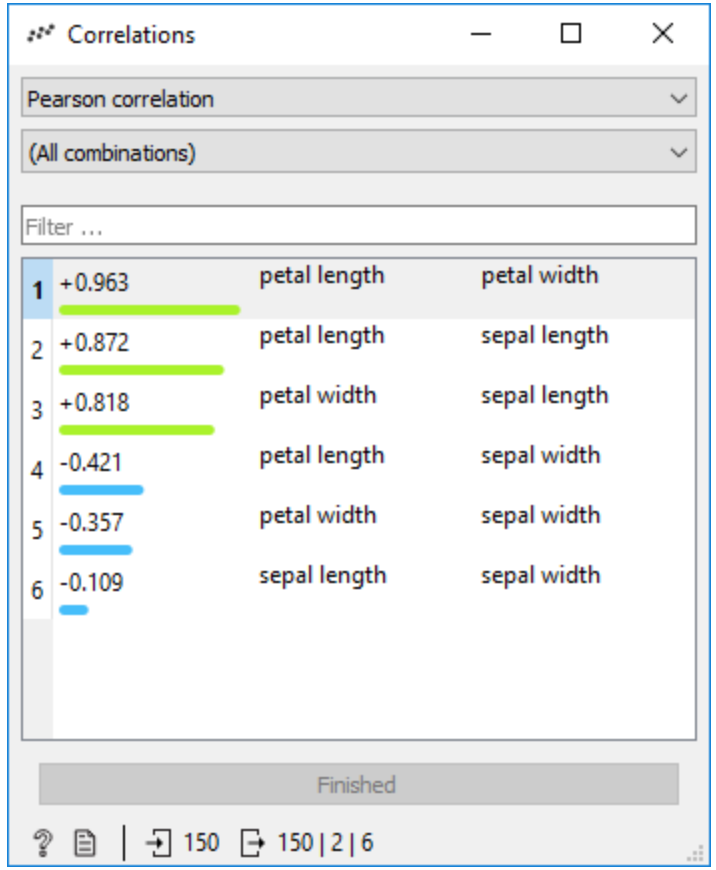
- Petal length seems the most important and sepal width is the least

➔ Feature selection

Orange EDA:

What are the most important features?





❑What to notice?

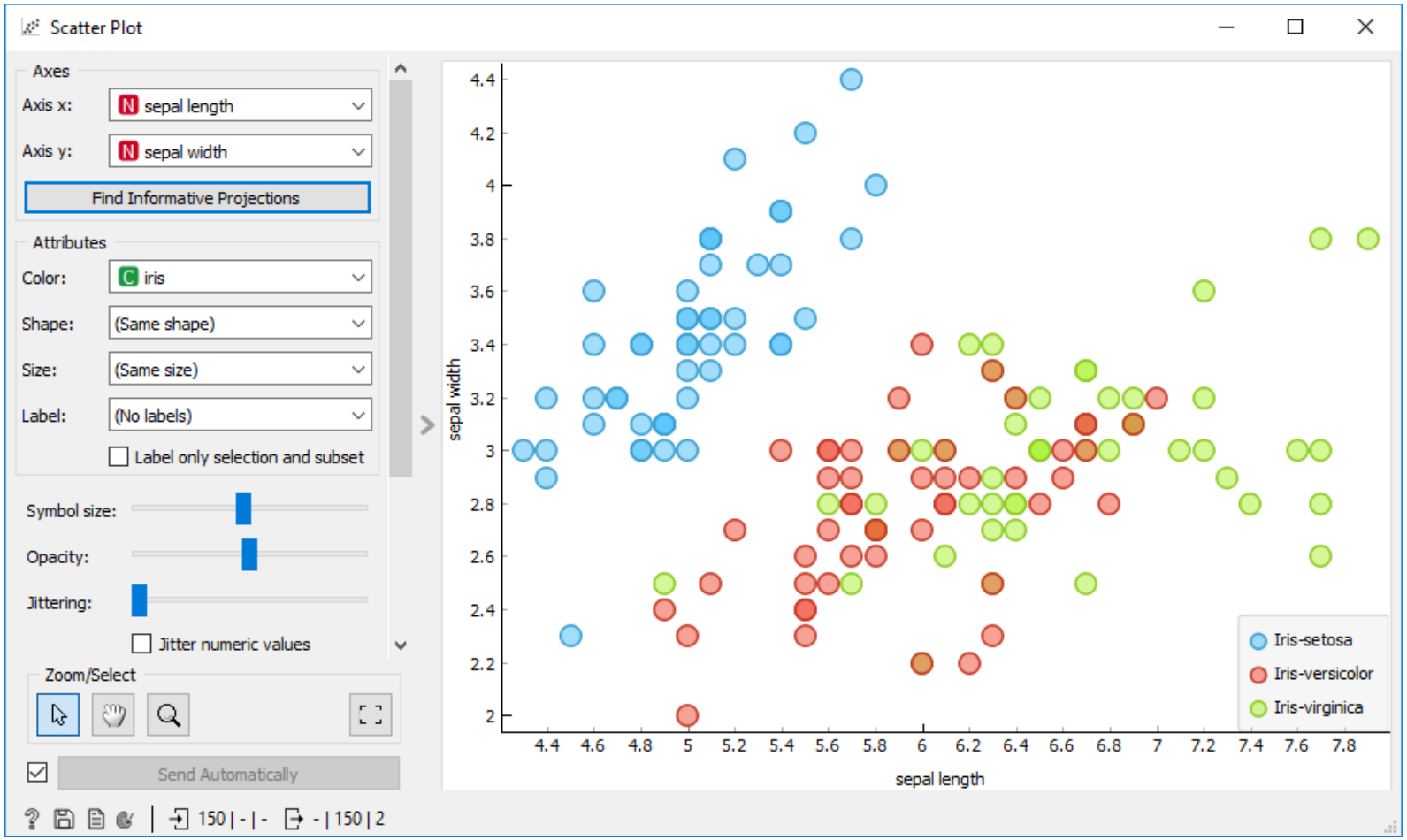
- [-1, 1], negative/positive, strong/weak…
- Petal length and petal width look strongly corelated

➔ Feature selection

Orange EDA:

What is the relationship between two variables (e.g. the sepal length and width) per/regardless class?

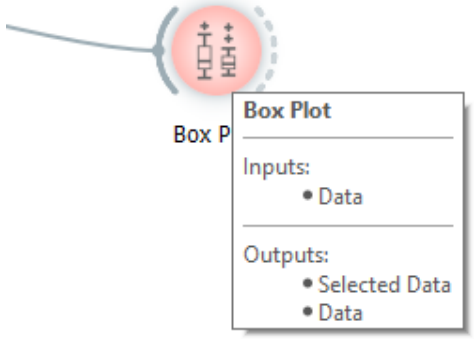
Scatter Plot



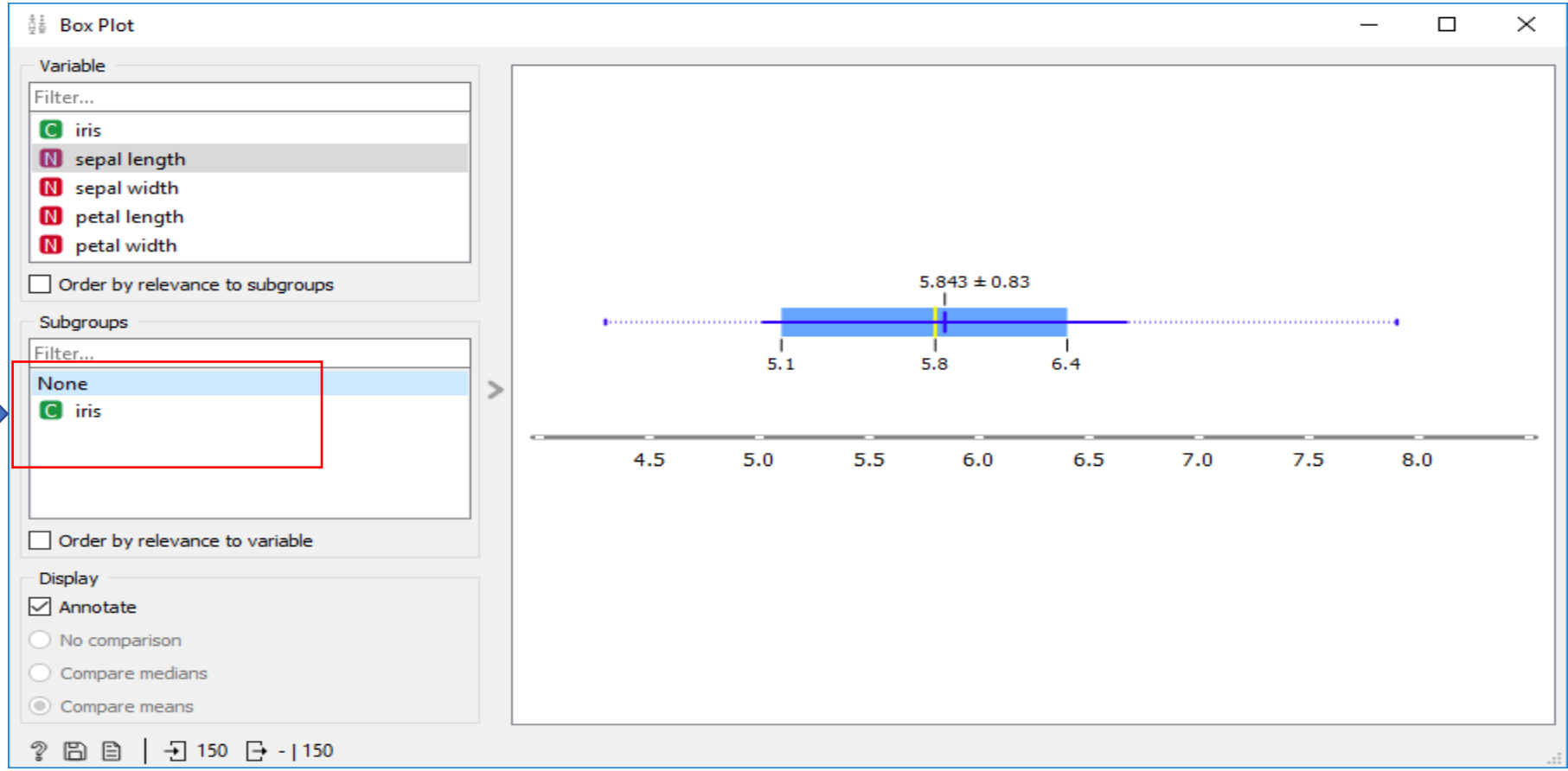
- Change variables
- What to notice?
- Compare with the correlation shown previously

Orange EDA:

How the values of a certain variable (e.g. sepal length) are distributed?



Univariate

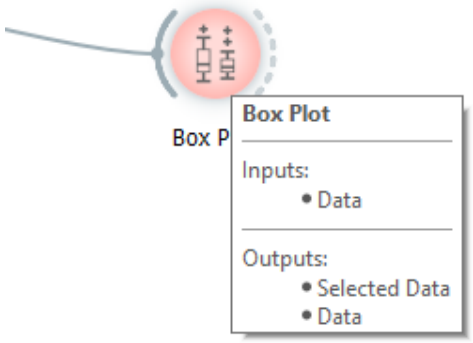


❑What to notice?

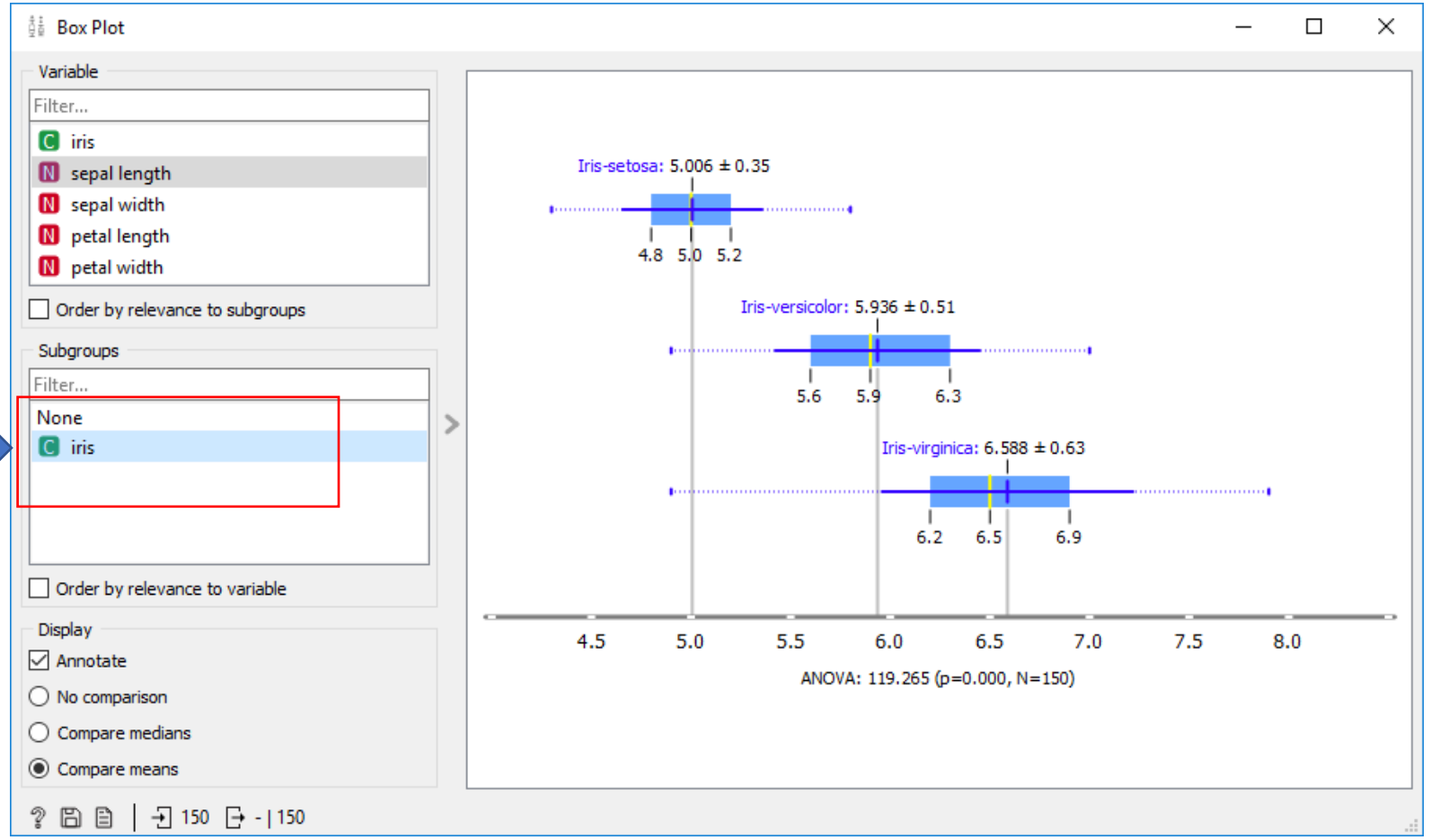
- Graphical presentation for the stats

Orange EDA:

How the values of a certain variable (e.g. sepal length) are distributed per target class (iris species)?



Multivariate

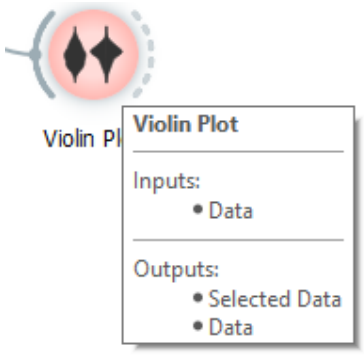


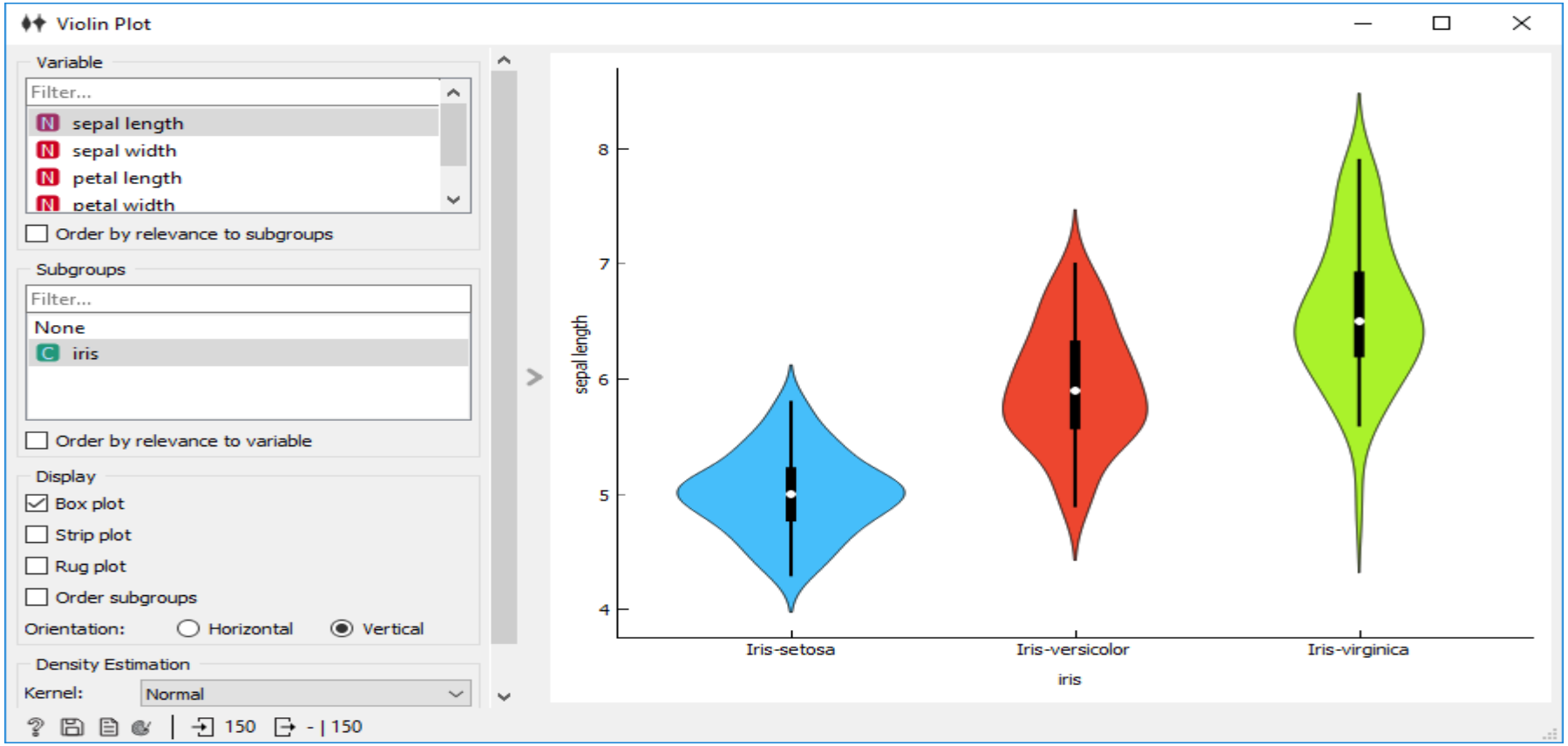
❑What to notice?

- Graphical presentation for the stats per class
- Small sepal length ➔ ieis-setosa class

Orange EDA:

How the values of a certain variable (e.g. sepal length) are distributed per target class (iris species)?



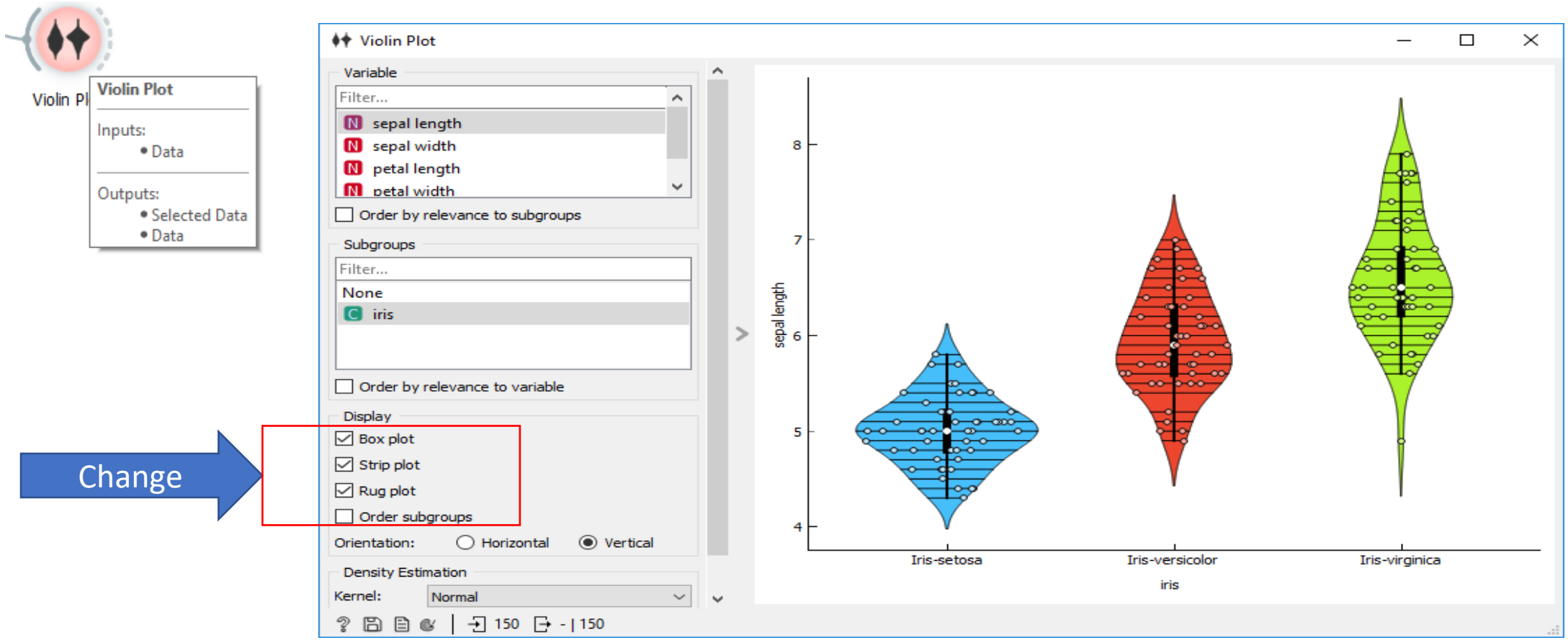


❑What to notice?

- Similar to box plot but the density/frequency of the samples for variable values is visualized

Orange EDA:

How the values of a certain variable (e.g. sepal length) are distributed per target class (iris species)?

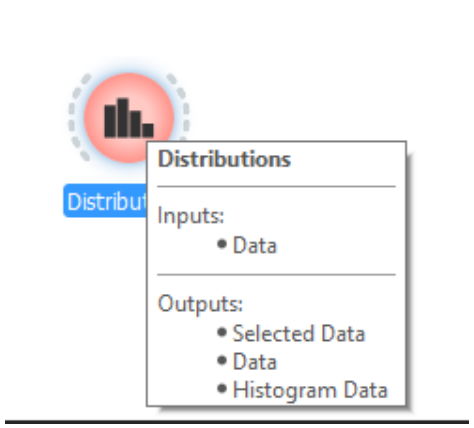


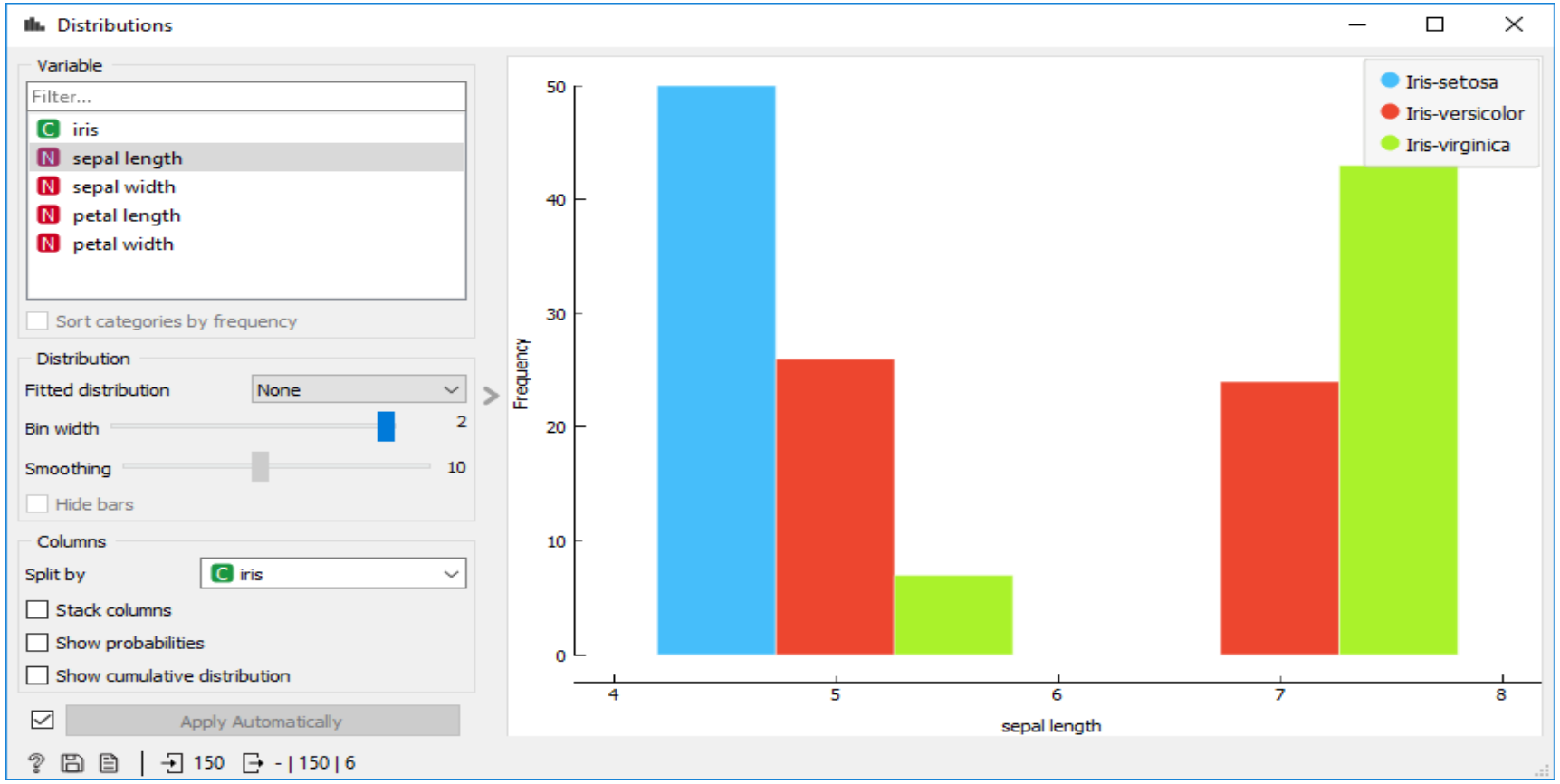
❑What to notice?

- Show the points for clearer visualization

Orange EDA:

How the values of a certain variable (e.g. sepal length) are distributed per target class (iris species)?





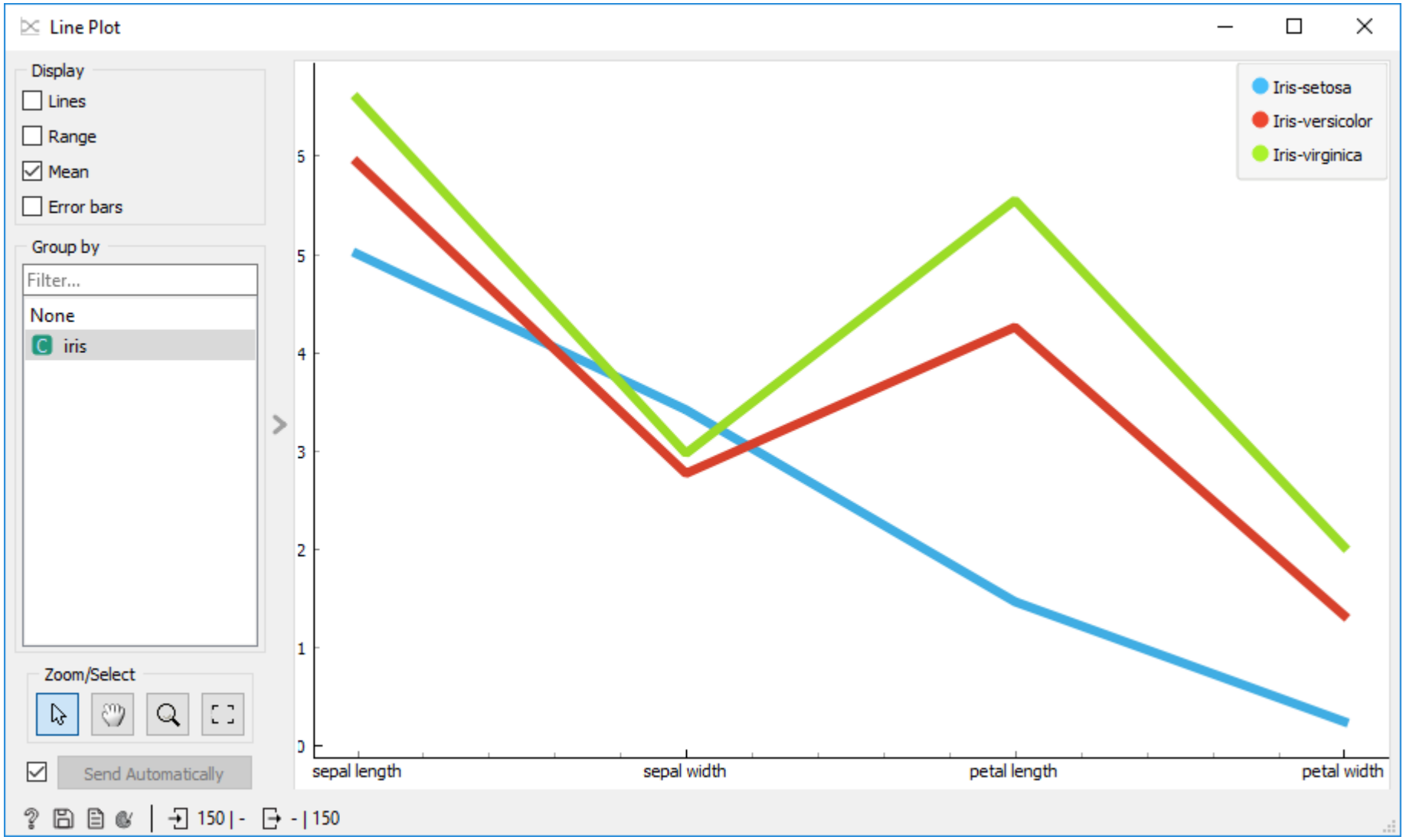
❑What to notice?

- Shorter sepal ➔Iris-setosa
- Longer sepal ➔ more likely Iris-virginica

Orange EDA:

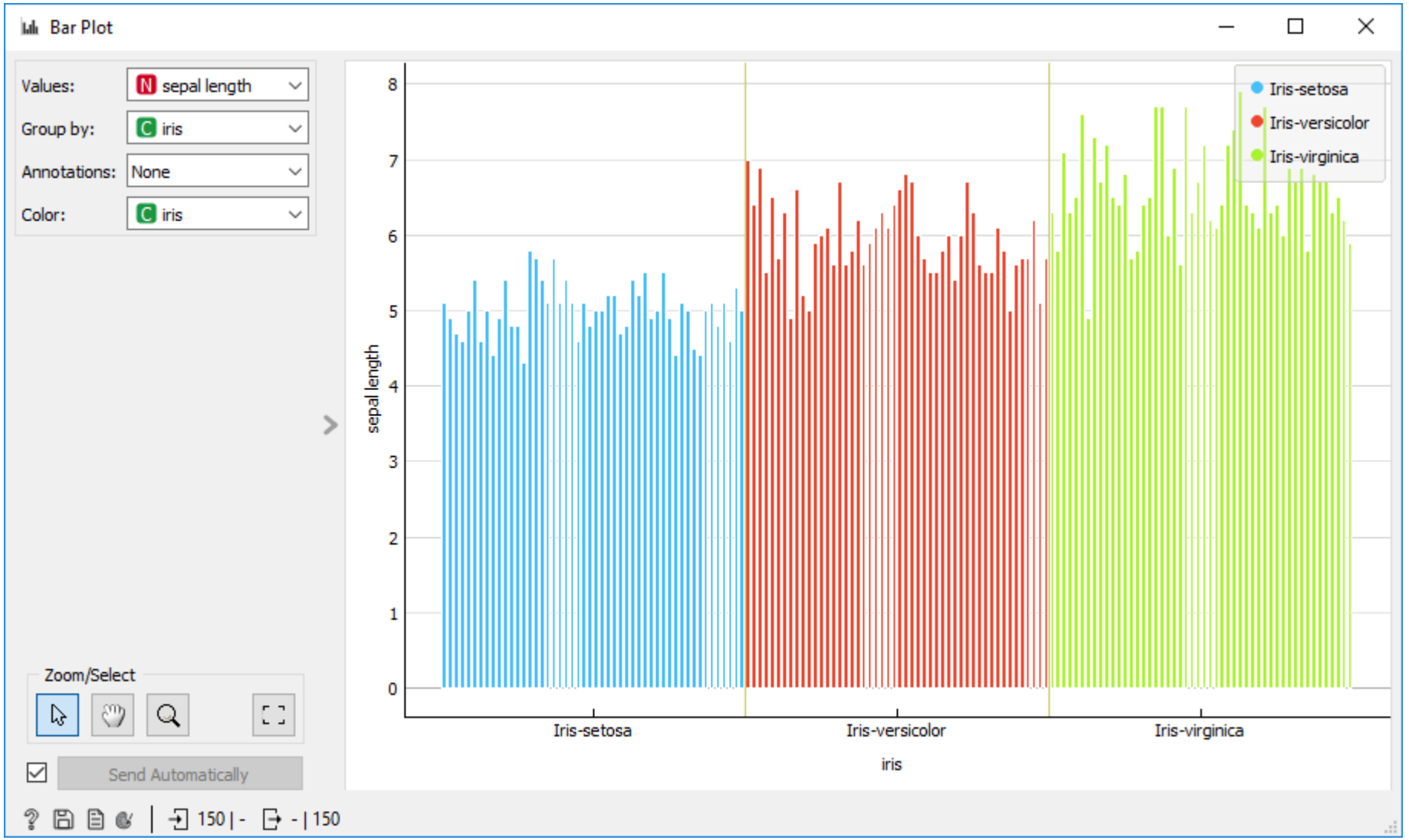
How the values of input variables are distributed per target class?

Line Plot



Orange EDA:

How the values of input variables are distributed w.r.t. another variable?



Orange EDA

- Why there are different ways to answer the same question?